

FINAL REPORT

October 2016

**Assessing Beaver Habitat on Federal Lands in New Mexico
Assistance Agreement # CD00F434-01A (FY2011)**



Beaver dam on El Rito Creek in the Carson National Forest, Northern NM

**New Mexico Environment Department
Surface Water Quality Bureau
Wetlands Program**

Table of Contents

Project Goals and Objectives	3
Description of the Project	7
Project Location and Past History.....	17
Project Outcomes	19
Original Timeframe	21
Partners Involved	21
Funding	23
Project Highlights and Chronology	23
List of Major Deliverables (on file at NMED)	29
Lessons Learned.....	30
What Made the Project Successful	30
What Made the Project Not So Successful	31
Technical Transfer	31
EPA Feedback Loop	31
Future Activity Recommendations	32

Project Goals and Objectives

The goals of this project were to: 1) update wetland mapping for 3,900 square miles in Northern NM near the Jemez Mountains where beaver populations are known to occur; 2) identify beaver habitat on all federal lands in NM using a Geographic Information System (GIS) model; and 3) convene experts at a *Beaver and Wetlands Workshop* to exchange information and promote recovery of dam-building beaver populations throughout New Mexico.

Objective 1. Mapping and Classification of Wetlands in the Jemez Mountains

The SWQB Wetlands Program is updating and expanding the current wetlands inventory across the state. Accurate and up-to date mapping of wetlands provides the basis for a greater understanding of wetland resources throughout the state, to monitor changes and trends, identify rare wetland types, select mitigation sites and coordinate protection of wetlands by agencies and partners. The SWQB Wetlands Program partnered with Saint Mary's University of Minnesota, GeoSpatial Services (Geospatial Services) and a Technical Advisory Committee (various state and federal agencies) to map wetlands at a 1:12,000 scale across the landscape. *Mapping and Classification of Wetlands in the Jemez Mountains* included mapping of wetlands (including linear wetlands), riparian areas and deepwater habitats for 3,900 square miles (2.5 million acres) in Rio Arriba, Sandoval, Los Alamos and Santa Fe counties. This includes portions of the Jemez, Rio Chama, Rio Puerco, Upper San Juan, Conejos, and Upper Rio Grande watersheds.

Wetlands were identified using four different classification systems: 1) National Wetlands Inventory Cowardin Classification (Cowardin et al., 1979); 2) A System for Mapping Riparian Areas in the Western United States (USFWS, 2009); 3) Landscape Position, Landform, Waterbody Type, Water Flow Path (LLWW) mapping classification and descriptors (Tiner, 2011); and 4) Hydrogeomorphic (HGM) Classification (Brinson, 1993). A wetland is defined in the US Fish and Wildlife Service National Wetland Inventory as "land supporting hydrophytic plant communities, land with hydric soils, or land where the water table is at or near the surface for part of the year." If these conditions are met the area can be identified and mapped as a wetland for the NWI. The completed NWI mapping is available at: www.fws.gov/wetlands/data/mapper.html. Riparian areas were mapped and classified according to A System for Mapping Riparian Areas in the Western United States, which is compatible and available on the NWI website.

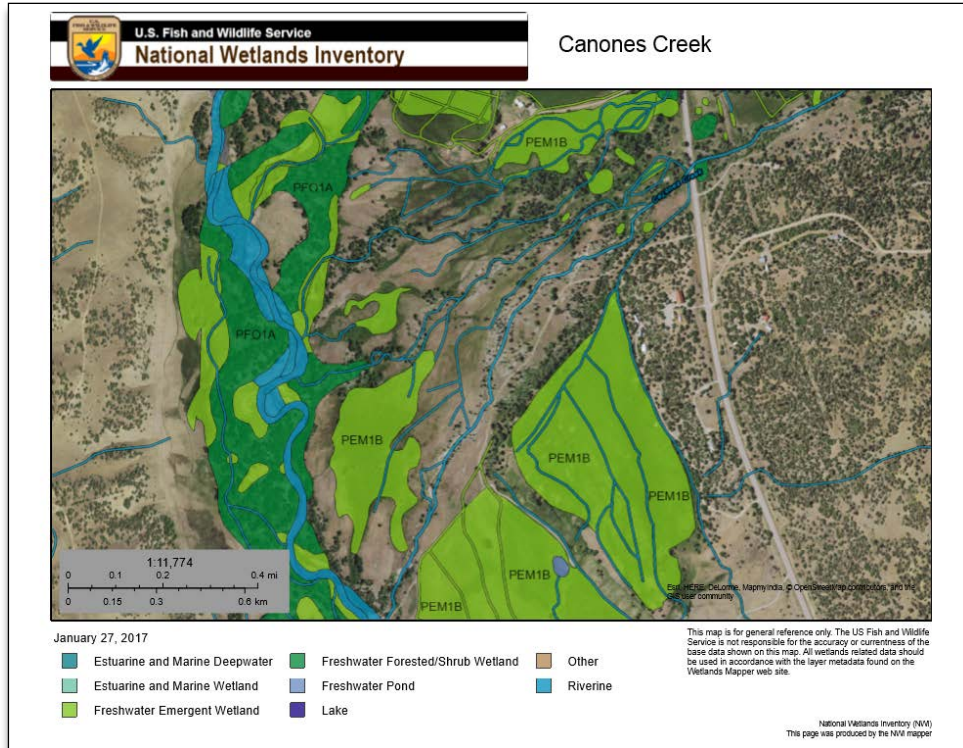


Figure 1. Example map produced from the NWI website of Cañones Creek at the confluence of Rio Chama in the project area.

Wetland areas were also classified using the LLWW system. This classification provides additional information about the movement of water and the location of the wetland on the landscape. Wetlands were then classified by assigning hydrogeomorphic (HGM) classes and subclasses. The HGM system provides an easily understood way to categorize wetlands and will be useful for future monitoring and assessment efforts.

The classification schemes allowed for very detailed descriptions of the wetlands that were then used to document 12 functions that are performed by wetlands: Aquatic Invertebrate Habitat, Bank and Shoreline Stabilization, Carbon Sequestration, Fish Habitat, Groundwater Recharge, Nutrient Transformation, Sediment and Particulate Retention, Streamflow Maintenance, Surface Water Detention, Unique, Uncommon, or Highly Diverse Wetland Plant Communities, Waterfowl and Waterbird Habitat, and Wildlife Habitat. Finally, wetlands were categorized as either high or moderate for the performance of these specific functions relative to other wetlands in the project area.

All of the wetland mapping and classification data are available in a geodatabase from the SWQB Wetlands Program. The data are useful for a variety of applications, such as wetlands planning, protection, assessment, restoration, coordination with other agencies

and landowners, and monitoring long-term trends. Interactive maps are also available in PDF map format for the Canjilon, Chama, and Sulphur Creek (Valles Caldera) areas.

Objective 2. Beaver Habitat Assessment Model

The *Beaver Habitat Assessment Model* was designed to increase understanding of the positive correlation between beaver population and wetland acreage, and develop interest and capacity for the future implementation of beaver habitat improvement and beaver reintroduction projects on federal lands. Due to the unique hydrological engineering accomplished by dam-building beaver, reestablishment of beaver and the wetland habitats they create and sustain constitutes an important climate change adaptation tool. This is because healthy wetlands can promote ecological adaptation to changing climate through natural ecological resiliency, connectivity across habitats, linkages between aquatic and terrestrial ecosystems, and expanded thermal refugia.

The SWQB Wetlands Program partnered with WildEarth Guardians and Bird's Eye View GIS to create a GIS model for occupied, potential and suitable habitat for dam-building beaver on federal lands in New Mexico. Background research and a technical steering committee consisting of beaver habitat experts drove the decision-making for model establishment. The main habitat requirements for dam-building beaver are streams with low slope gradients, on lower order streams, in areas with sufficient food. Considering these requirements, the model included several habitat factors: stream gradient, stream order, existing vegetation type, canopy cover and road density.

The results of the model include three GIS layers: Potential Beaver Habitat, Suitable Beaver Habitat, and Occupied Beaver Habitat. The Potential Beaver Habitat layer shows areas that have the necessary physical characteristics for beavers but have a lack of woody vegetation that beavers need for food and dam-building. The Suitable Beaver Habitat layer represents areas that have the physical and biological characteristics necessary for beavers to live, and suitability is ranked from lowest to highest. The Occupied Beaver Habitat layer represents information on where beavers were known to be living in 2013.

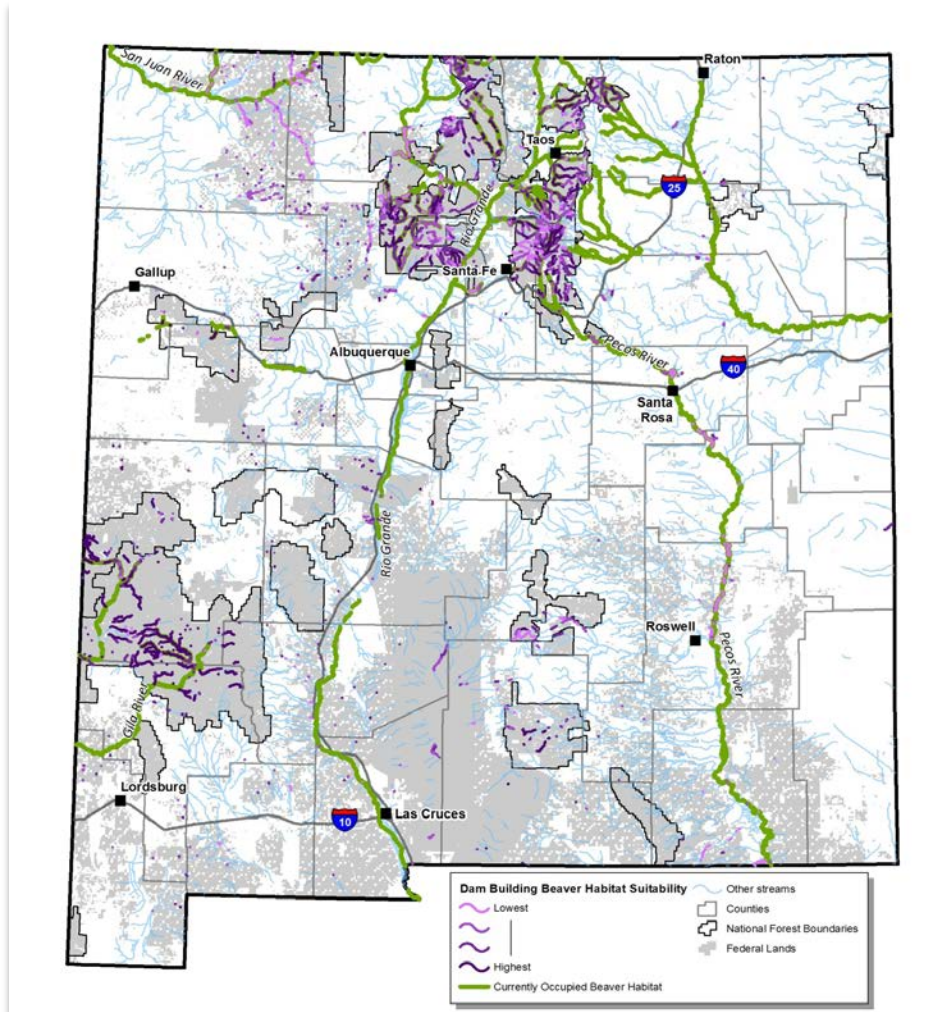


Figure 2. Beaver Habitat Assessment Model for federal lands showing suitable habitat in purple.

The *Beaver Habitat Assessment Model* is available at: <https://gis.web.env.nm.gov/SWQB/>. On the website, the user can zoom in to see an area of interest. The model is a useful planning tool that provides a landscape scale assessment of beaver habitat. The model can be used to prioritize areas for beaver habitat and wetlands restoration; however, additional site specific evaluation is necessary prior to conducting restoration in a particular area.

Objective 3. Beaver and Wetlands Workshop

Sixty-five participants from state and local agencies, organizations, tribes and landowners attended the 2013 *Beaver and Wetlands Workshop*. The workshop focused on: the science of beaver and wetlands; the *Beaver Habitat Assessment Model*; a tool for predicting where beaver habitat can be established; the Utah Beaver Management Plan – 2010-2020, and how it was developed with multiple stakeholders; and strategies and

techniques to protect property from beaver so that humans and beaver can co-exist without conflict. Professional facilitator Julia Barnes led a discussion on the opportunities and challenges for wetlands and beaver during which participants expressed ideas, questions, views and concerns about beaver, the scientific information about this keystone species, and societal impacts of beaver and water resources.

Description of the Project

Mapping and Classification of Wetlands in the Jemez Mountains

The mapping and classification project component used geospatial techniques and image interpretation processes to remotely map and classify wetlands, deepwater habitat and riparian areas. Wetlands for the project area were mapped and classified in GIS using on-screen digitizing methods. This process was supported by development of a selective interpretation key that resulted from field verification of image signatures and wetland classifications at over 350 on-the ground locations within the project area. Wetland image interpretation employed a variety of input image and collateral data sources as well as field verification techniques. All mapping was completed at an on-screen zoom scale of 1:12,000 or larger in compliance with the national wetland mapping standards.

The project mapped wetlands within 3,900 square miles (approximately 2.5 million acres) of New Mexico land area in Rio Arriba, Sandoval, Los Alamos and Santa Fe counties. The project area included portions of Jemez, Rio Chama, Rio Puerco, Upper San Juan, Conejos, and Upper Rio Grande watersheds.

Results of the mapping effort include:

- **51,540 acres** of wetlands, riparian and deepwater habitat were mapped and classified.
- **26,000 polygons** (each representing wetlands >½ acre) and
- **11,000 linear features** (total length 6,676 miles) were mapped and classified.
- **2.06%** of the total project area is wetlands, riparian or deepwater habitat.
- Based on the Cowardin classification:
 - **70%** of the wetlands in the project area are palustrine,
 - **24.66%** are lacustrine, and
 - **5.34%** are riverine.

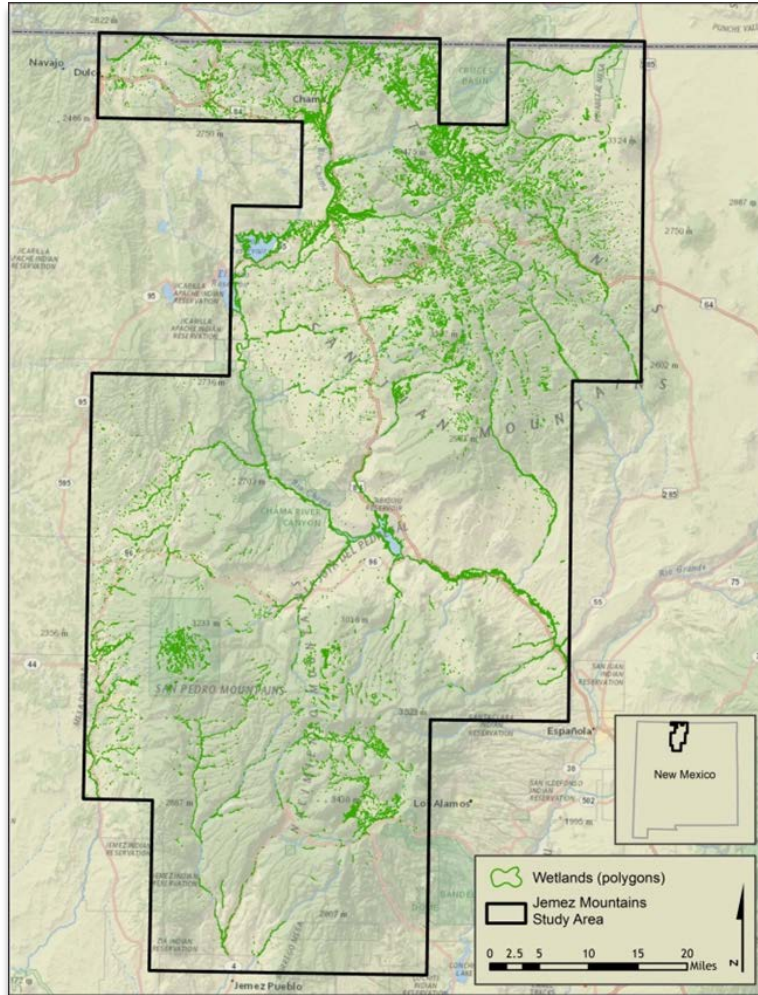


Figure 3. Overview of completed mapping in the project area showing the 26,000 mapped polygons. At this scale the wetland polygons appear as clusters of green in the wettest areas.

Wetlands were concurrently mapped using the Federal Geographic Data Committee (FGDC) Wetland Mapping Standard and the LLWW classification (Tiner, 2011). Riparian areas were mapped and classified according to A System for Mapping Riparian Areas in the Western United States (USFWS, 2009).



Figure 4. Stewart Meadows on the Rio San Antonio adjacent to New Mexico Highway 441 in Rio Arriba County. The NWI classification for this type of common wetland (darker green area in the middle of the photo) is *PEMIC* (Palustrine, Emergent, Persistent, and Seasonally Flooded).



Figure 5. The NWI classification for Abiquiu Lake in Rio Arriba County is *L1UBHh*, (Lacustrine, Limnetic, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded).

Classification of wetlands using the FGDC Wetlands Mapping Standard, combined with the addition of LLWW descriptors and the development of a wetland functional correlation table for New Mexico, provided the opportunity to assign functional attributes

to all wetland habitats in the project area. The functional assessment schema was developed through a ‘best professional judgment’ exercise and was based on the consensus of local, regional and national wetland biologists and natural resource professionals plus local stakeholders who were familiar with wetland habitats in the project area (Technical Advisory Committee). The first step in this process was to develop consensus amongst the Committee on the wetland functions that were important to assess for the project area. The group was then asked to document the wetland characteristics that were representative of specific functions and to correlate them to both NWI and LLWW codes. Finally, wetlands were categorized as either high or moderate for the performance of specific functions relative to other wetlands in the project area.

Wetland functions that were assessed are listed in the table below.

Table 1. Wetland functions evaluated in the project.

#	Function	Description
1.	Aquatic Invertebrate Habitat	Provides habitat for aquatic invertebrates
2.	Bank and Shoreline Stabilization	Wetland vegetation helps bind soil to limit or prevent bank and shoreline erosion
3.	Carbon Sequestration	Serves as a carbon sink that helps trap and store atmospheric carbon
4.	Fish Habitat	Provides habitat for a variety of fish (including a special category containing factors that maintain cold water temperatures for certain species including trout)
5.	Groundwater Recharge	Sustains sub-surface water storage, base flow and hyporheic exchange.
6.	Nutrient Transformation	Encourages the cycling of nutrients from natural sources or anthropogenic sources
7.	Sediment and Particulate Retention	Acts as filters to physically trap sediment particles before they are carried further downstream
8.	Streamflow Maintenance	Provides a source of water to sustain streams from drying up during periods of drought conditions or low discharge
9.	Surface Water Detention	Stores runoff from precipitation events or spring melt waters which reduce the force of peak flood levels downstream
10.	Unique, Uncommon, or Highly Diverse Wetland Plant Communities	Sustains natural vegetation and ecosystems including unique and uncommon wetland types and rare species

11.	Waterfowl and Waterbird Habitat	Provides habitat for waterfowl and other water birds
12.	Wildlife Habitat	Provides habitat for a variety of wildlife (resident and migratory)

Results from the wetland functional assessment indicated that Groundwater Recharge, Waterfowl and Water Bird Habitat, and Other Wildlife Habitat were the most commonly occurring wetland functions in the project area and were performed by most wetlands. The least common function performed was the Unique, Uncommon, or Highly Diverse Wetland Plant Communities Function.

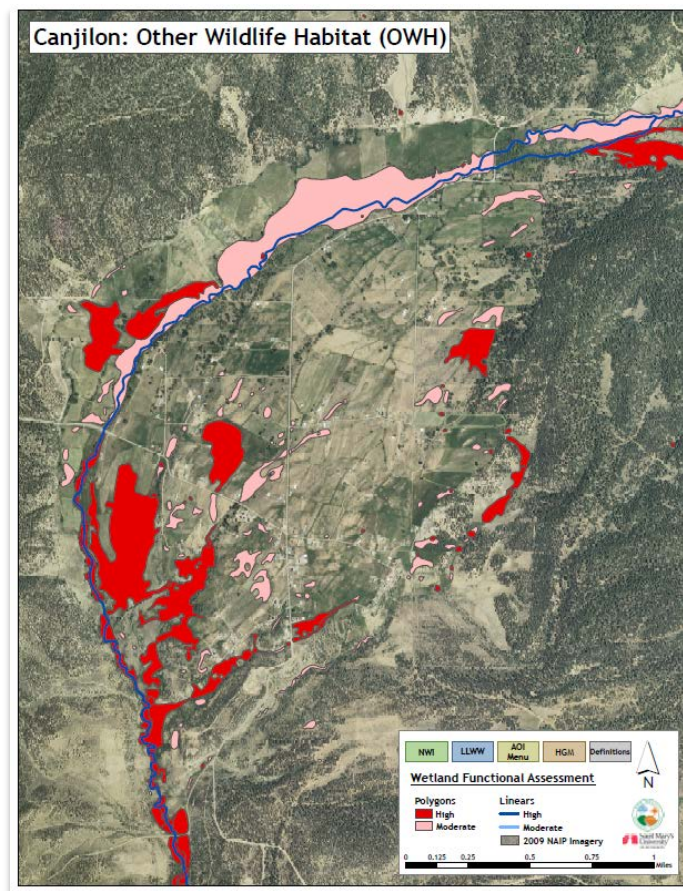


Figure 6. Example of wetland mapping of functions. The map shows where wetlands are performing the Other Wildlife Habitat function in the Canjilon area.

All mapped wetlands, including linears and isolated wetlands, were characterized by HGM descriptors (Brinson, 1993) for class and subclass.

Table 2. HGM Classes, subclasses and modifiers used in the project.

HGM CLASS	HGM SUBCLASS	HGM MODIFIER
Depressional	Playa	Excavated Inflow
Excavated Outflow		
Excavated Vertical Flow		
Inflow		
Outflow		
Vertical Flow		
Artificial		Excavated
Impounded		
Pond Fringe Excavated		
Pond Fringe Impounded		
Natural		Inflow
Outflow		
Vertical Flow		
Bidirectional Throughflow		
Throughflow		
Pond Fringe Inflow		
Pond Fringe Outflow		
Pond Fringe Throughflow		
Pond Fringe Vertical Flow		
Riverine	Sub-alpine alpine	Null
Alluvial Fan		Null
Episodic		Null
Montane-Unconfined		Null
Montane Canyon Confined		Null
Lowland Unconfined		Null
Lowland Canyon Confined		Null
Slope	Headwater	Springfed
Null		
Springfed		Null
Other		Inflow
Outflow		
Vertical Flow		
Through Flow		
Lacustrine Fringe	Lake	Null
Flats	Mineral	Null
Organic		Null

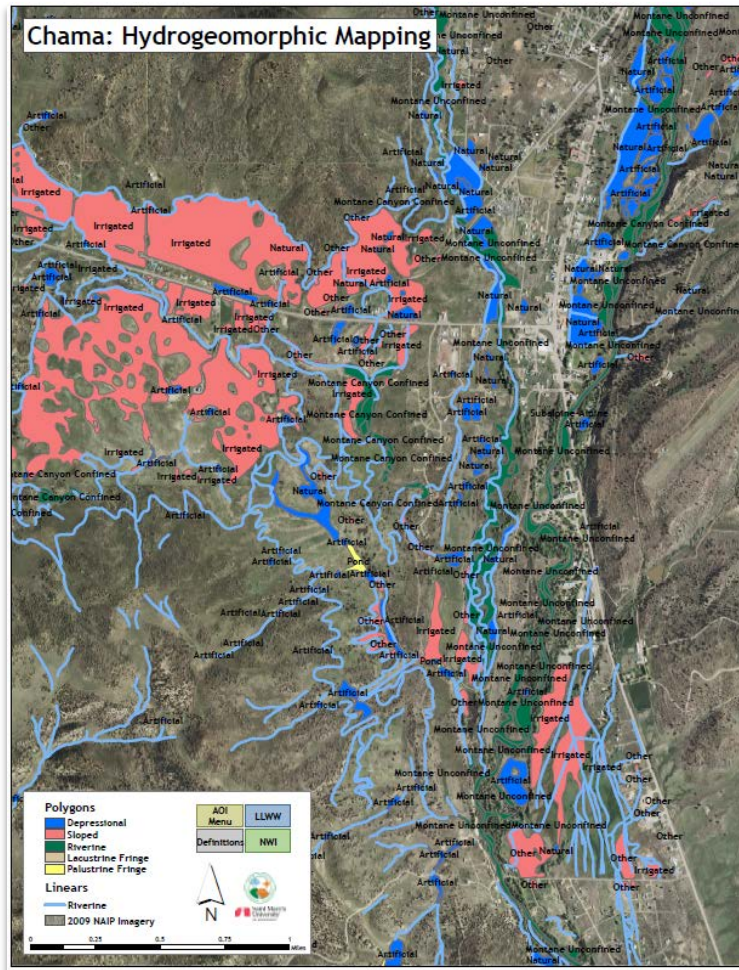


Figure 7. HGM map for the Chama area showing depressional, slope, riverine, and palustrine fringe wetlands in the area.

The NWI Cowardin Classification mapping and classification was submitted to the US Fish and Wildlife Service for inclusion in the National Wetlands Inventory after performing QA/QC on the data. The data are available to the public at <http://www.fws.gov/wetlands/Data/Mapper.html>.

The SWQB Wetlands Program plans to submit the LLWW data to the Wetlands One Stop website, also known as the NWI Plus Mapper for special project data at: <http://www.aswm.org/wetland-science/wetlands-one-stop-mapping/5043-nwiweb-mapper>. This website is operated by the Association of State Wetland Managers, and currently there is no funding for posting new information.

All of the wetlands data for *Mapping and Classification of Wetlands in the Jemez Mountains* were included in a large ArcGIS geodatabase that is available from NMED for use by watershed groups, agencies and anyone that has the capability to use GIS. A final report by GeoSpatial Services describes the attributes of the geodatabase and how the wetlands mapping and classification were conducted.

Three interactive PDF documents were developed for areas where they are anticipated to be useful: Chama, Valle Seco, and Canjilon. The PDF documents show all of the GIS layers in a single document: NWI, LLWW, HGM, and 12 wetland functions.

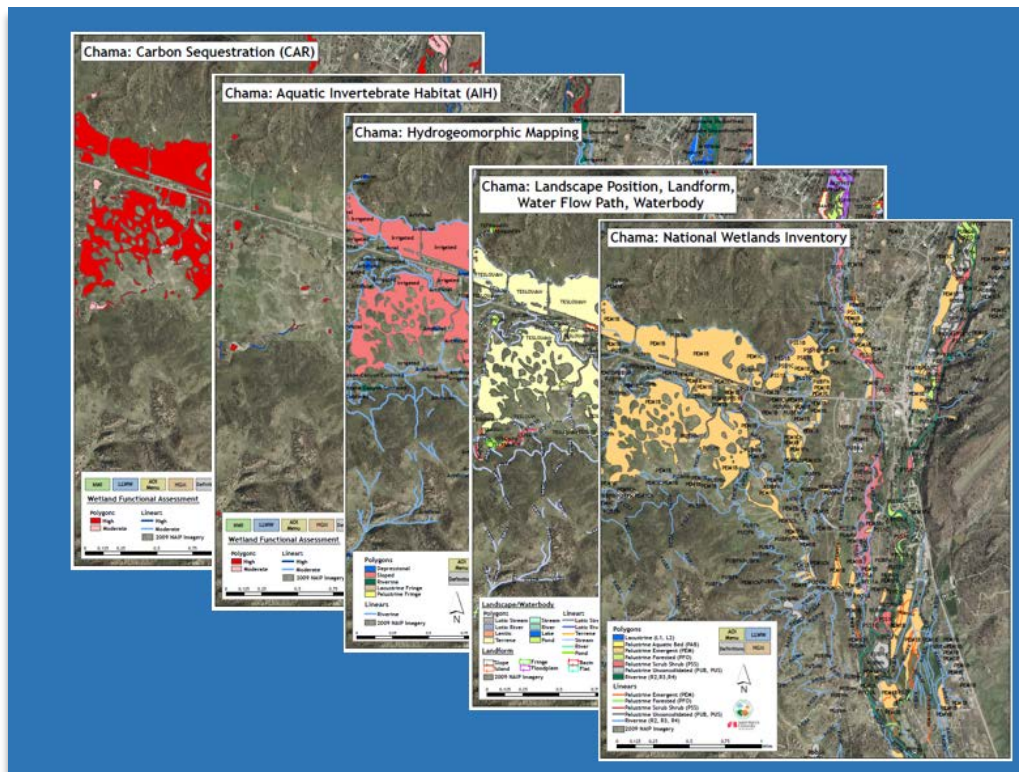


Figure 8. A selection of pages from the Map Book for the Chama area.

Beaver Habitat Assessment Model

The *Beaver Habitat Assessment Model* used GIS to model potential and suitable habitat for dam-building beaver. Background research and a technical steering committee consisting of beaver habitat experts drove the decision-making for model establishment. The main habitat requirements for dam-building beaver are streams with low slope gradients, on lower order streams, in areas with sufficient food. Considering these requirements, the model included several habitat factors: stream gradient, stream order, existing vegetation type, canopy cover and road density. Road density is a surrogate

measurement of human infrastructure and was included because roads can be a limiting factor for beaver occupation.

The results of the model include three GIS layers: Potential Beaver Habitat, Suitable Beaver Habitat, and Occupied Beaver Habitat. The potential habitat layer shows areas that have the necessary physical characteristics for beavers but have a lack of woody vegetation that beavers need for food and dam-building. The suitable layer represents areas that have the physical and biological characteristics necessary for beavers to live, and suitability is ranked from lowest to highest. The occupied layer represents information on where beavers were known to be living in 2013.

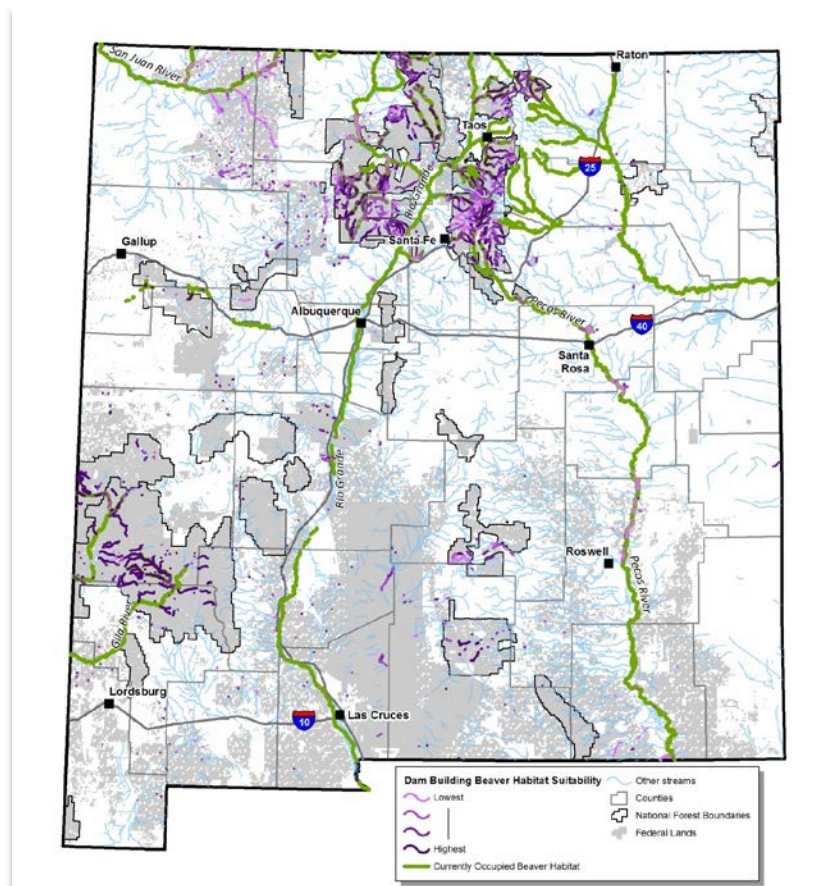


Figure 9. Occupied Beaver Habitat (known occupations in 2013).

The Occupied Beaver Habitat layer is based on known occupations by the NM Department of Game and Fish in 2013. Beaver populations are dynamic and this layer can only be considered a rough snapshot in time.

The model was ground-truthed in the Jemez Mountains by comparing field observations with the statewide model data for existing vegetation type, canopy cover and stream gradient. A team of student interns gathered data at 18 randomly selected sites that the model had determined to be suitable beaver habitat. Existing vegetation type was determined by observing the majority vegetation type at each point. Canopy cover was determined by using a spherical densiometer at each point. Stream gradient was determined by using a clinometer. Results of the ground-truthing indicated a reasonable correlation, but in several cases the vegetation observed did not match the model. The reason for this was the low resolution of the vegetation layer in the model, however, there were no higher resolution data available.

The *Beaver Habitat Assessment Model* is a useful planning tool that provides a landscape scale assessment of beaver habitat. The model can be used to prioritize areas for beaver habitat and wetlands restoration; however, additional site specific evaluation is necessary prior to conducting restoration in a particular area.

Beaver and Wetlands Workshop

The model was shared at the *Beaver and Wetlands Workshop* on May 9, 2013, which was attended by 65 participants from a variety of organizations and agencies. Below is a summary of topics presented.

- Dr. Jennifer Frey presented on the science of beaver and wetlands, with a focus on the ecosystem services provided by beaver.
- Maryann McGraw provided an introduction on the objectives of the “Assessing Beaver Habitat on Federal Lands in New Mexico.”
- Joe Wheaton, Department of Watershed Sciences, Utah State University, described: 1) a GIS model for predicting where beaver habitat can be established, 2) beaver habitat restoration projects in Utah and Oregon, and 3) a simple mobile phone application for monitoring beaver presence in the field.
- Bryan Bird, WildEarth Guardians, and Kurt Menke Bird’s Eye View GIS provided an overview of the GIS beaver habitat assessment model for federal lands in New Mexico.
- Justin Dolling, Utah Division of Wildlife Resources, presented by telephone (we also showed his powerpoint presentation) about how the State of Utah developed a statewide beaver management plan with multiple stakeholders.

- Facilitator Julia Barnes led a discussion on the opportunities and challenges for wetlands and beaver during which participants expressed questions, views and concerns about scientific and sociological aspects of beaver.
- David Blagg and Phil Carter, Animal Protection of New Mexico, talked about strategies and techniques to protect property from beaver so that humans and beaver can co-exist without conflict.

Project Location and Past History

Beavers are referred to as ecosystems engineers because of their ability to drastically modify riparian landscapes. Beaver dams provide many benefits including: improving water quality, storing surface water and ground water, reducing downstream flood impacts, and providing habitat to diverse terrestrial, avian and aquatic species. There is a strong correlation between the presence of beavers and the health and abundance of wetlands; conversely, wetlands can become degraded as the water table drops after beaver dams are removed from an area.

Due to the unique hydrological engineering accomplished by dam-building beaver, (*Castor canadensis*) reestablishment of beaver and the wetland habitats they create and sustain constitutes an important climate change adaptation tool. Restoration of wetland and riparian ecosystems has been deemed more important than ever in the face of ongoing and unpredictable climate change. This is because healthy wetlands can promote ecological adaptation to changing climate through natural ecological resiliency, connectivity across habitats, linkages between aquatic and terrestrial ecosystems, and expanded thermal refugia. Ecosystem benefits commence immediately when beaver dams are built in suitable habitat and often continue long after dams are abandoned, in the form of retained ponds, wetlands, and/or meadows, and expanded riparian habitat, with the associated climate-adapting ecosystem services these provide. The current absence of beaver from significant portions of their historic habitat significantly undermines the resilience of aquatic ecosystems and therefore limits adaptation to climate change.

Prior to successful reestablishment of beaver and their wetland habitats, a systematic and thorough assessment of potential and suitable habitats as well as identification of impediments to successful recovery was necessary. The project area for the *Beaver Habitat Assessment Model* includes all federally managed lands in New Mexico. The project focused on federal lands because of the opportunity and need to address beaver habitat on large tracts of land with federal land managers, versus working with many small parcel landowners.

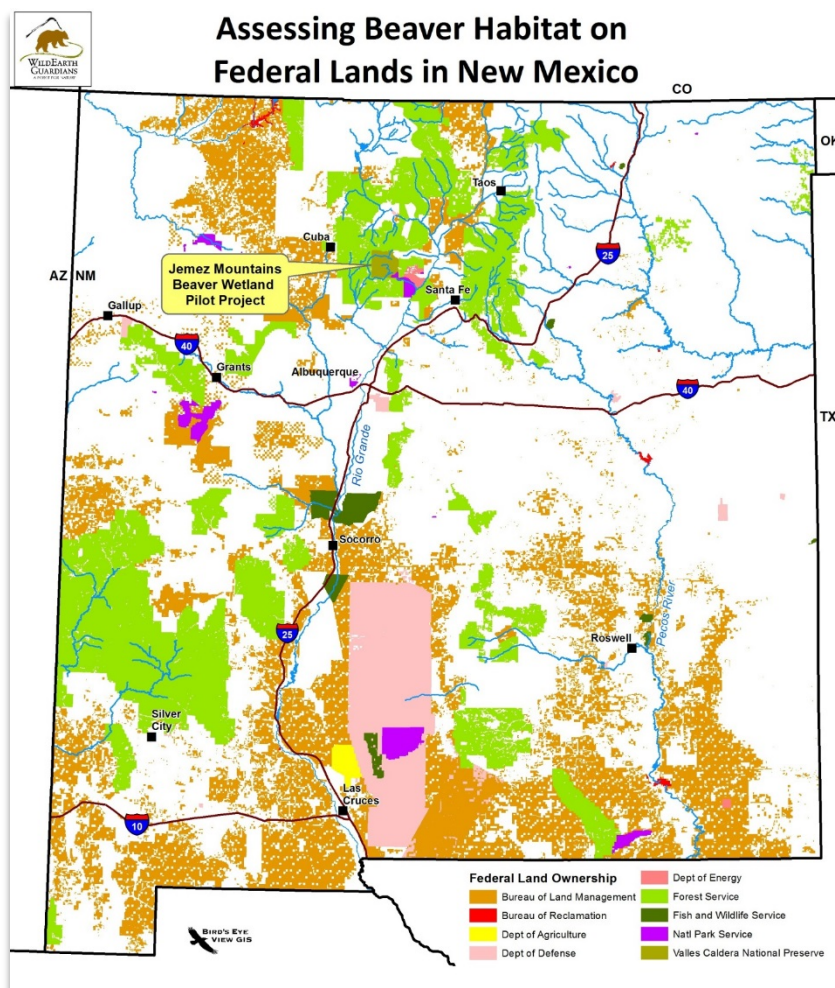


Figure 10. Map showing federal land ownership in New Mexico. The *Beaver Habitat Assessment Model* focuses on public lands.

Mapping and Classification of Wetlands in the Jemez Mountains builds on the *Mapping and Classification for Wetlands Protection, Northeastern New Mexico Highlands and Plains* project that mapped 19,755 square miles of Northeastern New Mexico, including the Canadian River watershed, the Dry Cimarron watershed, the Upper Gallinas watershed, the Upper Pecos watershed, part of the Upper Rio Grande watershed, and all US Forest Service wilderness wetlands. Methods developed for that project were applied to a new project area that includes the Jemez Mountains and the area north to the New Mexico – Colorado state line. Tribal lands and recently mapped wilderness areas were not mapped during this project. The available funding also covered a small amount of mapping in Santa Fe County, southeast of the project area, in order to fill gaps in the NWI.

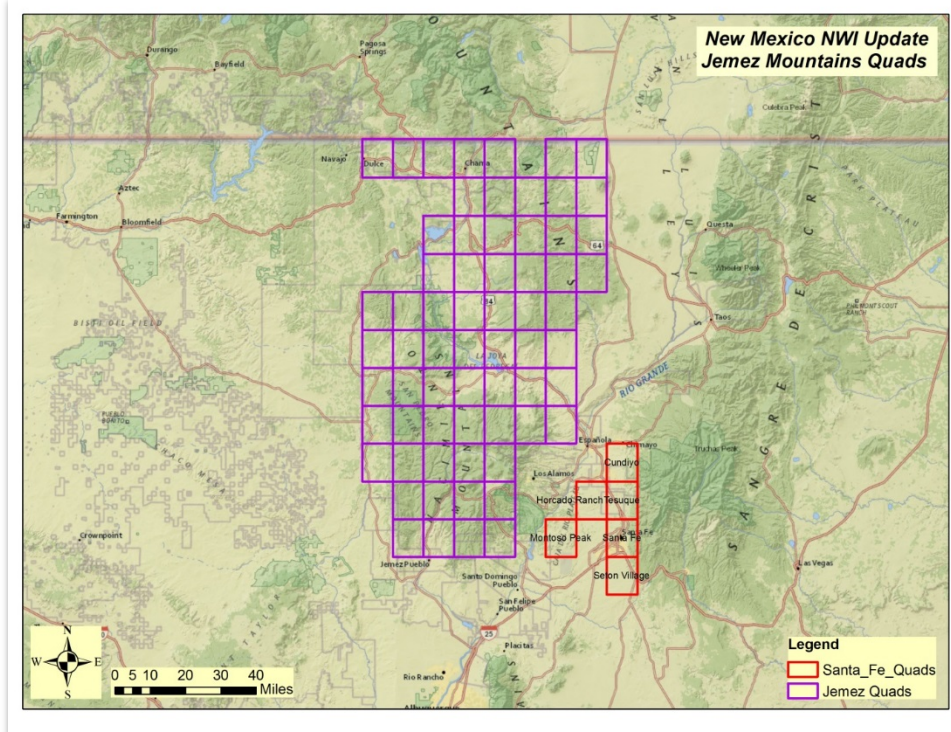


Figure 11. Map showing boundaries of the wetlands mapping area. The purple lines indicate the original 55 quadrangle equivalents that were mapped, and the red areas indicate an additional 5 quadrangle equivalents that were mapped in order to fill information gaps.

Project Outcomes

The results of the *Mapping and Classification of Wetlands in the Jemez Mountains*, the *Beaver Habitat Assessment Model*, and the *Beaver and Wetlands Workshop* have been acknowledged on the local and national level. Mapping information was shared with agencies, watershed groups and non-profits who are using it for a variety of state and local efforts.

- Updated mapping for 3,900 square miles (approximately 2.5 million acres) is now publicly available on the NWI Mapper.
- Stephanie Santell with the Office of Water at US EPA Headquarters created a promotional paper about this project in October 2016, to promote a greater understanding of how state agencies are factoring climate-related concerns into their water program operations, and to hopefully inspire others.

- SWQB Wetlands Program provided information about the results of this project to ASWM as a part of a larger project to promote collaborative beaver reintroduction in the arid west, and beaver habitat restoration as a step towards resiliency of montane river systems to climate change. The SWQB Wetlands Program will continue to participate in these efforts as an extension of this project.
- The National Park Service and Los Amigos de Valles Caldera are using the products from *Mapping and Classification of Wetlands in the Jemez Mountains* to plan wetland restoration projects in the Valles Caldera National Preserve.
- The SWQB Point Source Section used the interactive wetlands PDF map for Chama in November 2016 to evaluate wetlands for a wastewater outfall diversion project downstream of the Chama wastewater treatment plant.
- Amigos Bravos is using the products from *Mapping and Classification of Wetlands in the Jemez Mountains* to propose Wetland Jewels for special protection consideration on the Santa Fe National Forest.
- WildEarth Guardians is using the *Beaver Habitat Assessment Model* to identify, prioritize and seek federal, state and private funding for habitat and water quality planting projects on federal lands.
- The SWQB Wetlands Program continues to assist land management agencies in prioritizing areas of NM for beaver habitat restoration. The NM Department of Game and Fish updated the NM State Wildlife Action Plan in 2016 (pending approval by US Fish and Wildlife Service). The plan lists beaver reintroduction and habitat restoration as a proposed conservation action for all ecoregions in the state.
- The NM Department of Game and Fish and SWQB Wetlands Program are using the products from *Mapping and Classification of Wetlands in the Jemez Mountains* to plan for wetlands and beaver habitat restoration on the Rio Chamita in northern New Mexico.

Original Timeframe

The grant agreement that included this project was approved on December 21, 2011 and was scheduled to be completed by October 31, 2015. The grant award was amended for no-cost extension to October 31, 2016. The final year was used to complete an additional five quadrangles of mapping and classification in Santa Fe County, to complete the HGM classifications of all wetlands in the project area, and to update the final products with the HGM classifications.

Partners Involved

- Major cooperators included the project Contractors GeoSpatial Services of Saint Mary's University of Minnesota and WildEarth Guardians.
- Andrew Robertson, John Anderson, David Rokus, Kevin Stark (GeoSpatial Services of Saint Mary's University of Minnesota), the principal contractor for *Mapping and Classification of Wetlands in the Jemez Mountains*, provided expertise and guidance, in addition to \$25,360.00 in contractor match. Andrew Robertson and John Anderson also provided outstanding organizational and field mapping skills to make visits to 352 field check sites possible within a short amount of time.



Figure 12. Andrew Robertson and John Anderson of GeoSpatial Services viewing a slope wetland during the mapping field review at the headwaters of Sulphur Creek in the Valles Caldera National Preserve.

- Zachary Stauber (NMED GIS Coordinator) helped with contractor selection, provided collateral data sets to contractors, and provided guidance to help place the map products on the NMED Mapper.

- Elizabeth Zeiler (NMED GIS Analyst) helped with contractor selection, developed a consolidated database of each map layer and provided guidance for uploading the database on the NMED mapper and wetlands website.
- Jim Dick, Regional Wetland Coordinator, US Fish and Wildlife Service, provided technical assistance with NWI mapping. He participated in the mapping Technical Advisory Committee and conducted quality assurance and inclusion of wetland mapping data produced by this project in the NWI.
- In addition to the Wetlands Program Coordinator, Wetlands Project Officer and the Contractors, the following people/organizations also participated in the mapping Technical Advisory Committee: Scott Compton, Valles Caldera National Preserve; Roy Jemison, Candace Bogart, Bart Mathews and Amber Anderson, US Forest Service-Southwestern Regional Office; David Park, US Forest Service-Santa Fe National Forest; David Certain, NM State Parks Division; James Hirsch, Michael Gustin, and Chuck Schultz, NM Department of Game and Fish; Valerie Williams, US Bureau of Land Management; Christopher Parrish, US Army Corps of Engineers; Ryan Besser and Pam Herrera-Olivas, US Bureau of Land Management-Taos Field Office; Jim Matison, WildEarth Guardians; and Jessica Johnston, Aguas Norteñas.
- Bryan Bird, WildEarth Guardians, the principal contractor for the model, worked with subcontractor Kurt Menke, Bird's Eye View GIS, to develop the *Beaver Habitat Assessment Model*, and organized speakers for the *Beaver and Wetlands Workshop*.
- Interns for WildEarth Guardians ground-truthed the *Beaver Habitat Assessment Model* and assisted with writing reports. The interns were: Debra Budrow, Environmental Scientist; and Drake Hebert, Andrew Nguyen, and Janelle Roybal, graduate students at the University of California, Santa Barbara-Bren School of Environmental Science.
- Speakers at the *Beaver and Wetlands Workshop* included: Julia Barnes, Facilitator; Dr. Jennifer Frey; Maryann McGraw, Surface Water Quality Bureau, NMED; Dr. Joe Wheaton, Dept. of Watershed Sciences, Utah State University; Bryan Bird, WildEarth Guardians; Kurt Menke, Bird's Eye View GIS; Justin Dolling, Utah Division of Wildlife Resources; David Blagg; and Phil Carter, Animal Protection of New Mexico.
- The Technical Steering Committee for *Beaver Habitat Assessment Model* included: The WPO, WPC, Bryan Bird, WildEarth Guardians; Kurt Menke, Bird's Eye View GIS; Eric Hein, US Fish and Wildlife Service; Jennifer Frey, Dept. of Fish, Wildlife and

Conservation Ecology, NM State University; Will Amy, US Forest Service; Ron Maes, US Forest Service; Jack Williams, US Forest Service; James Stuart, NM Department of Game and Fish; Bill Dunn, University of New Mexico; Greg Gustina, US Bureau of Land Management; Robert Findling, The Nature Conservancy; and David Blagg.

Funding

The original federal amount was **\$207,431.00** and the original match amount was **\$69,219.00**. The final federal amount spent was **\$204,042.39** and the final match amount was **\$71,464.00**.

Project Highlights and Chronology

- The project was approved and funded by EPA on September 21, 2011.
- Procurement was conducted through a Request for Quotes for the *Beaver Habitat Assessment Model* and *Beaver and Wetlands Workshop*. A contract was executed with WildEarth Guardians on August 13, 2012.
- The first technical steering committee meeting was held on September 24, 2012 to inform the GIS model for beaver habitat and identify threats and obstacles to beaver recovery/reintroduction.
- EPA approved the PQAPP (QTRAK #13-169) for the *Beaver Habitat Assessment Model* on February 12, 2013. The PQAPPs were distributed to all those involved in data collection, and acknowledgement forms were signed to assure compliance with PQAPP procedures. For the model, project monitoring included field checks and establishing photo monitoring points in the Jemez Mountains.
- Procurement was conducted through a Request for Proposals for *Mapping and Classification of Wetlands in the Jemez Mountains*. A contract was executed with GeoSpatial Services of Saint Mary's University of Minnesota on March 13, 2013.
- A GoTo webinar meeting was held on March 13, 2013 with GeoSpatial Services to kick off *Mapping and Classification of Wetlands in the Jemez Mountains*.
- EPA approved the PQAPP (QTRAK #13-263) for *Mapping and Classification of Wetlands in the Jemez Mountains* on April 30, 2013. Project monitoring included pre-and post-mapping field checks for verification and quality assurance.
- A Direct Purchase Order with Julia Barnes, Professional Facilitator, was issued on March 20, 2013 for facilitation of the *Beaver and Wetlands Workshop*.

- The *Beaver and Wetlands Workshop* was conducted on May 9, 2013. Sixty-five participants attended the workshop from a variety of organizations and agencies.
- The Wetlands Program Coordinator, Wetlands Project Officer and GeoSpatial Services conducted the first ½ day technical advisory committee meeting for the *Mapping and Classification of Wetlands in the Jemez Mountains* on May 20, 2013, and a 3 ½ day pre-mapping field check on May 20-23, 2013. A total of 350 wetlands sites were field checked during the trip.



Figure 13. Beaver dam complex on the Rio Cebolla below Fenton Lake Dam in Fenton Lake State Park, Jemez Mountains.

- The second technical steering committee meeting for the *Beaver Habitat Assessment Model* was held on May 29, 2013 by conference call.
- Ground-truthing of the *Beaver Habitat Assessment Model* was conducted during June and July 2013 in the Jemez Mountains by WildEarth Guardians and graduate students from the Bren School of Environmental Science and Management at the University of California, Santa Barbara. The objective of ground-truthing was to assess on-the-ground conditions to determine the model's accuracy in predicting suitable beaver habitat. WildEarth Guardians utilized two Global Positioning System (GPS) units in tablet format. A base map was uploaded to the units with existing wetlands, streams and topographic maps. Data dictionaries for beaver habitat and wetlands were uploaded to the units as well. Training sessions were

held to familiarize the Wetlands Project Officer and the college student field workers with tablet operation. Field workers collected photographic and GPS data, measured canopy cover, stream gradient, distance to roads, and performed a vegetation greenline assessment along the water's edge and transects across the riparian zone. Field data were imported into the WildEarth Guardians/Bird's Eye View GIS database. The ground-truthing showed that overall there was a good level of model accuracy, but there were inaccuracies in the identification of vegetation due to limitations of the GIS layer that is available statewide for vegetation.



Figure 14. Beaver dam and lodge on Rio Cebolla at the confluence with Rio Guadalupe in the Jemez Mountains, May 2013. The red arrow points to the beaver lodge.

- The Wetlands Project Officer completed a 40-hour Wetland Delineation training course with the Wetlands Training Institute on July 8-12, 2013. The lecture portion of the training was online, and the field portion was in Laramie, Wyoming.
- The Wetlands Project Officer met with Contractor WildEarth Guardians on August 28, 2013 to review the completed *Beaver Habitat Assessment Model*.
- The Wetlands Project Officer met with the SWQB Bureau Chief and management of the New Mexico Department of Game and Fish in September 2013 to discuss dissemination and application of the *Beaver Habitat Assessment Model*.

Assessing Beaver Habitat of Federal Lands in New Mexico Final Report

- The Wetlands Project Officer attended the *Developing Southwest Wetlands Programs for Tribes* conference in Islet, NM on November 5, 2013.
- The Wetlands Project Officer presented the *Beaver Habitat Assessment Model* at the annual coordination meeting between NMED SWQB and the US Forest Service on November 13, 2013. Managers from the Carson, Cibola, Gila and Lincoln national forests attended, as well as representatives from the southwest regional office.
- EPA approved the annual PQAPP update (QTRACK #14-248) for *Mapping and Classification of Wetlands in the Jemez Mountains* on April 23, 2014.
- Amendment 1 for the contract with GeoSpatial Services of Saint Mary's University of Minnesota for mapping and classification was executed on May 1, 2014. This amendment added contractual funding for two days of field work to the pre-mapping field review and extended deliverable deadlines.
- The Wetland Program Coordinator, Wetlands Project Officer and GeoSpatial Services conducted the second technical advisory committee meeting for *Mapping and Classification of Wetlands in the Jemez Mountains* and a draft map field review on May 28-31, 2014. The meeting was for 1 ½ days and the field review was for an additional 2 ½ days.



Figure 15. Second technical advisory committee meeting at Valles Caldera National Preserve offices in Jemez Springs, NM.

- On November 19, 2014, the Wetlands Project Officer participated in an Association of State Wetland Managers (ASWM) Wetland Mapping Consortium webinar *titled Variable Width Riparian Areas Mapping: A Robust GIS Approach*.
- Amendment 2 for the contract with GeoSpatial Services of Saint Mary's University of Minnesota for mapping and classification was executed on December 30, 2014. This amendment added mapping for five quadrangles and an update to the mapping products and final report to include the HGM classification system.
- The Wetlands Project Officer attended a Natural Channel Design Workshop on *Geomorphic Processes and Restoration of Natural Channels in the Arid Southwest* on March 24-27, 2015 in Prescott, Arizona (personnel hours for attending the training were charged to this project).
- The Wetland Project Officer met numerous times with GeoSpatial Services by GoTo Webinar to discuss technical questions about the wetlands mapping and classification, including on: March 13, 2013; April 8, 2013; March 13, 2014; June 19, 2014; July 15, 2014; August 12, 2014; January 29, 2015; February 18, 2015; March 11, 2015; March 18, 2015; April 30, 2015; June 19, 2015; August 10, 2015; August 31, 2015; November 24, 2015; and January 21, 2016.
- The Wetlands Project Officer, Wetlands Program Coordinator and GeoSpatial Services participated in a meeting on March 21, 2016 to identify Wetland Jewels in the Santa Fe National Forest for future wetland protection and restoration actions. The WPO gave a presentation about the mapping project and potential uses for the products.
- Continued interest in the *Beaver and Wetland Workshop* and *Beaver Habitat Assessment Model* was demonstrated by calls in March 2015 from Brian David, Wildlife Biologist, Payette National Forest, Idaho, and Kent Woodruff, Wildlife Biologist, US Fish and Wildlife, Washington. Mr. Davis was interested in information from the workshop which he would use to give presentation to landowners with private inholdings (in the national forest) about coexisting with beaver. Mr. Woodruff was surveying western states about actions that are being taken to support beaver.
- Brian Small, a graduate student with the New Mexico State University Department of Fish, Wildlife and Conservation Ecology, presented his master's degree research at the Southern New Mexico Wetlands Roundtable on April 9, 2014. The title of his thesis is: "Status of dam-building beaver on public lands in New Mexico: a comparison of occupied and vacant sites." Although his work is not directly part

of this project, Mr. Small attended the *Beaver and Wetlands Workshop* and his thesis work regarding the paucity of beavers and beaver habitat on public lands is consistent with the findings of this project.

- Contractor GeoSpatial Services submitted the final wetlands mapping and classification in June 2015. All deliverables were submitted to NMED, including the geodatabase, the final report, and three interactive PDF maps. The geodatabase was submitted to the US Fish and Wildlife Service and they added the mapping to the National Wetlands Inventory.
- EPA approved a grant extension request on October 6, 2015. The grant was extended from October 31, 2015 to October 31, 2016.
- The Wetlands Project Officer toured New Mexico Meadow Jumping Mouse (MJM) critical habitat (and potential habitat) in the Jemez Mountains on June 23, 2016 with Steven Plunkett, Assistant Threatened and Endangered Species Program Manager, US Forest Service, Southwestern Regional Office. In partnership with the US Fish and Wildlife Service, the US Forest Service has removed cattle from some areas to reduce the effects of grazing and allow wet meadows to recover. The NM MJM require 24-inch sedges for their habitat. Because of fencing out the cattle, the woody vegetation is also recovering in these areas and beaver habitat is re-establishing. Some of the potential habitat areas are locations where NMED has paid for willow planting projects with Clean Water Act Section 319(h) or state restoration funding.



Figure 16. Critical MJM habitat along the Rio Cebolla in the Jemez Mountains in an area that used to host beaver. Vegetation is recovering and will likely support beaver again soon.

- The Wetlands Project Officer worked with Stephanie Santell with the Office of Water at US EPA Headquarters to create a promotional paper about this project in October 2016.
- The Wetlands Project Officer created a poster board about the project and displayed it at an Exhibitor table at the Quivira Coalition Conference in Albuquerque on November 9-11, 2016. Fifty copies of EPA's promotional handout were distributed.

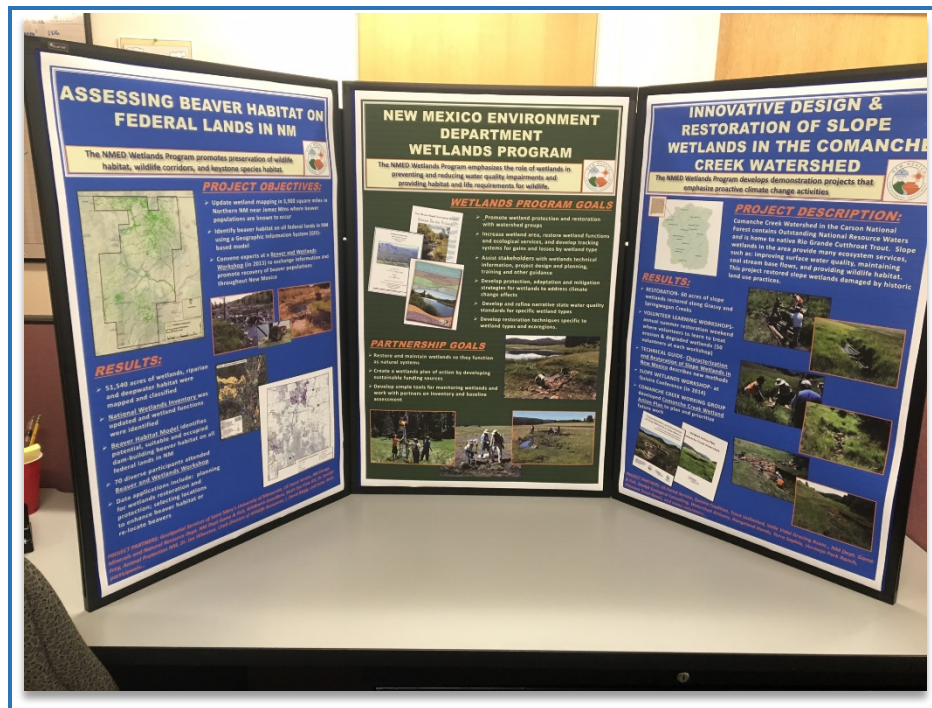


Figure 17. Exhibit board used at Quivira Coalition Conference, November 2016.

List of Major Deliverables (on file at NMED)

PQAPPs for the *Beaver Habitat Assessment Model* and for *Mapping and Classification of Wetlands in the Jemez Mountains*

Beaver Habitat Assessment Model and final report by Contractor Wild Earth Guardians, including ground-truthing

Final report on *Mapping and Classification of Wetlands in the Jemez Mountains* by Contractor Saint Mary's University of Minnesota, GeoSpatial Services

Pre-mapping and post-mapping field reports

Assessing Beaver Habitat of Federal Lands in New Mexico Final Report

Final mapping geodatabase

Interactive PDF maps for three areas

Poster presentation, informational handout, and power point presentation on the project

Semi-annual reports to EPA

Documentation of match

Final report

Lessons Learned

- A key lesson learned it that it is essential to involve local, regional, and national experts plus local stakeholders in the mapping and assessment processes in order to achieve the most accurate products.
- It is important to incorporate both field evaluations (qualitative and quantitative) and collateral spatial data sources in order to support decisions related to wetland delineation, classification, and function. This is especially true in an environment such as New Mexico that has undergone prolonged drought for several years. Also, this is a landscape level mapping project and the resulting data should be used to support decision making at that scale. It is appropriate to use these data as a guide for further field data collection and investigation, but not for determinations of site-specific compliance, restoration or mitigation activities.
- Project work plans should remain somewhat flexible in order to allow for the use of new technologies. For example, the work plan between NMED and EPA specified 100 maps as a deliverable. As the geodatabase for the mapping and classification was developed, it became evident that paper maps would not be the most useful products. The Contractor proposal interactive PDFs which were relatively new technology. ESRI Story Maps are other new methods being investigated to make the data available to the public and use friendly. Currently NMED is developing a Mapper on our website.

What Made the Project Successful

The *Beaver Habitat Assessment Model* and *Beaver and Wetlands Workshop* components of the project were successful because of the expertise and interest of the Contractor team, the Technical Steering Committee, the workshop speakers, and all of the workshop participants. The *Mapping and Classification of Wetlands in the Jemez Mountains* component was successful because of the Contractor's expertise in wetlands mapping

and classification, their willingness to apply developing technologies, and the knowledge of local and regional wetlands by Wetlands Program Coordinator, Wetlands Project Officer, and the Technical Advisory Committee.

What Made the Project Not So Successful

The *Beaver Habitat Assessment Model* and the *Beaver and Wetlands Workshop* may have been even more successful if the NM Department of Game and Fish had participated more. As NMED planned the *Beaver and Wetlands Workshop*, the NM Department of Game and Fish emphasized the nuisance aspect of the beaver rather than the important ecosystem services provided by beaver. NM Department of Game and Fish managers were also concerned that people would use the model to make independent decisions and actions about relocating beaver, without following proper procedures. To mitigate this concern, NMED put a Notice to the User on the project webpage, with a statement that anyone proposing to re-locate beaver must first contact the NM Department of Game and Fish and follow all applicable rules and regulations.

Although the NM Department of Game and Fish had written a letter of support for the project proposal, additional communication may have helped iron out concerns earlier and resulted in more cooperation and participation.

Completion of the *Mapping and Classification of Wetlands in the Jemez Mountains* portion of the project was somewhat delayed while waiting for the approach to the HGM Classification system to be developed through another mapping project: *Mapping and Classification for Wetlands Protection, Northeastern New Mexico Highlands and Plains*.

Technical Transfer

The SWQB Wetlands Program has promoted this project through the workshop, the SWQB Wetlands Program website, meetings with agencies and watershed groups, roundtables, and conferences, as described in the Project Chronology section of this report. The SWQB Wetlands Program webpage for the project is: <https://www.env.nm.gov/swqb/Wetlands/projects/Beavers/index.html>. Wetlands mapping and beaver habitat restoration are both components of the NM Wetlands Program Development Plan, therefore the SWQB Wetlands Program team will continue to share project results with individuals and at appropriate venues.

EPA Feedback Loop

EPA was supportive of this project, especially in allowing a grant period extension to allow additional time for mapping and classification, and to complete additional mapping work. This project built awareness and support for beaver recovery in New Mexico and

significantly increased knowledge of wetland resources through the mapping and classification. These types of projects should continue to be supported by EPA Region 6 Wetlands Program Development.

Future Activity Recommendations

Future activities for beaver habitat should include collaborating with local, state and regional efforts for beaver habitat and beaver recovery. Specifically, the SWQB Wetlands Program should work the NM Department of Game and Fish, US Fish and Wildlife Service, US Forest Service, US Bureau of Land Management, State Parks Division, and tribal entities to find ways to conserve and create beaver habitat. Ongoing assessment of suitable and occupied beaver habitat is needed because the beaver populations are dynamic in areas, especially in areas that are not fully occupied. Since the model was created in 2013, the WPO has observed locations where beaver have re-established, and others where beaver were present but are now gone.

Future activities for wetlands mapping and classification include: 1) continuing to do outreach on mapping and classification products to make people aware of wetland resources in their areas; 2) working with watershed groups to identify areas where the mapping products can be used to help develop Wetland Action Plans; 3) fulfilling existing grant requirements for mapping and classification in the Sacramento Mountains, Middle Rio Grande, and Southwestern New Mexico.

The NMED Wetlands Program will continue to seek funding to update NWI mapping throughout the remainder of New Mexico.



Figure 18. El Rito Creek in the Carson National Forest. Beaver dam, pond and lodge photographed on the May 2014 post-mapping field trip.